



Causes and consequences of sleep loss and fatigue: The worker perspective in the coral reef tourism industry

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ABSTRACT

This study provides an in-depth understanding of the causes and consequences of sleep loss and fatigue in the coral reef tourism industry. Utilizing a qualitative methodology, data were obtained from eight focus groups conducted in Far North Queensland with 42 reef tourism employees. Analysis involved identifying and inductively coding any emergent categories of the causes and consequences of sleep loss and fatigue. Findings are applied to Baum, Kralj, Robinson, and Solnet's (2016) taxonomy of tourism research to highlight where the causes of sleep loss and fatigue originate. This reflects individual, occupational and industry-level causes of sleep loss and fatigue which workers indicate have consequences for their wellbeing, and the safety and efficacy of their operations. Implications for the broader tourism industry are discussed.

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Introduction

Tourism operates within a competitive market. As a result, tourism managers are always looking for employees who can “perform well while providing a superior level of service quality” (Crawford & Hubbard, 2018). Frontline workers in the tourism and hospitality industries are expected to fulfil several roles. For example, they play an important role in ensuring a quality tourism experience irrespective of the tour setting (Black & Weiler, 2005). Workers need to be entertainers who are able to produce positive feelings and a comfortable atmosphere (Heung, 2008; Pabel & Pearce, 2016). As a labour-intensive industry, the interactions of frontline employees and tourists play a vital role in determining the success of a tourism business through customer relationship management (Johnson, Huang, & Doyle, 2019; Slatten & Mehmetoglu, 2011). An enthusiastic, motivated and loyal workforce can provide a competitive advantage (Janes & Wisnom, 2011) and supporting that workforce is critical for retaining talented, committed and knowledgeable staff.

While the tourism industry has a reputation for being fun and flexible, it is also known for its challenging employment practices (Janes & Wisnom, 2011). Long working hours, low pay, high turnover rates, demanding work conditions, seasonality issues, insecure employment, limited social protection and low opportunities for personal development are all common features of the sector (T. Baum, 2015; O'Leary & Deegan, 2005; Winchenbach, Hanna, & Miller, 2019).

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An explicit element of frontline tourism employment is the need to deliver “service with a smile” (Grandey & Sayre, 2019, p. 1). Surface acting (i.e. modifying outward appearance and behaviour through facial expressions, gestures and tone of voice) has been shown to have negative consequences for the workers, including physical symptoms, burnout, and job dissatisfaction (Hulsheger & Schewe, 2011). Workers who find it challenging to perform emotional labour through surface acting are more likely to quit their job, leading to greater turnover which is costly for both individual worker and organization (Chau, Dahling, Levy, & Diefendorff, 2009). When there is an imbalance between the demands to perform emotional labour, and the capacity or ability of a worker to perform these demands, emotional labour dysregulation emerges. Emotional labour dysregulation impacts the reef tourism industry in Australia (Pabel, Naweed, Ferguson, & Reynolds, 2019).

In addition to the many social and contextual demands of a tourism workplace, customers are often reliant on staff for safety and wellbeing. This is particularly the case with reef tourism, as open water is a foreign environment for many customers. In addition to the usual job requirements, staff also play a safety-critical role, which is why it is surprising that limited focus has been given to the safety implications for the tourism workforce (Baum et al., 2016), particularly within specialty sectors like reef tourism.

Causes and consequences of sleep loss and fatigue

A key consideration in safety-critical workforces is fatigue. Fatigue in the occupational context is generally understood as perceived or actual exhaustion which impacts negatively on work safety, productivity and efficacy (Safe Work Australia, 2020). Broadly, fatigue can be attributed to both physical and mental exhaustion, and can arise from multiple factors. These include task requirements (effort and duration), inadequate sleep, circadian misalignment (as seen in shift work or irregular work hours), and long periods of time awake (Brown, 1994).

Causes of sleep loss and fatigue have been explored in numerous occupational contexts with safety-critical elements. Healthcare workers often report sleep loss and fatigue as a consequence of long work hours, exhaustion and insufficient time to recover and sleep between work shifts (Dorrian et al., 2008). Insufficient sleep in flight schedules has also been linked with emotional reactivity and operational safety in aviation settings (Drury, Ferguson, & Thomas, 2012). Long duty periods (e.g. long-haul flights), extremely early or late start times to fit flight schedules, and rapid shifts in time zones have all been identified as causes of sleep loss and fatigue in commercial pilots (Hartzler, 2014). Similar factors are linked with fatigue in Australian train drivers, as well as organizational and management issues (Filtness & Naweed, 2017; Naweed, Chapman, Allan, & Trigg, 2017).

The consequences of sleep loss and fatigue are significant. Broadly speaking, fatigue is associated with increased risk of errors and accidents (Thomas, Paterson, Jay, Matthews, & Ferguson, 2019). Fatigue plays a role in road traffic accidents, including fatalities (Dawson, Reynolds, van Dongen, & Thomas, 2018), and is linked with major safety breaches in the rail industry (Filtness & Naweed, 2017). Many of the causes of sleep loss and fatigue identified in workers (e.g. long work hours, shift work) are also associated with adverse health outcomes (Kecklund & Axelsson, 2016; Reynolds et al., 2018). Thus, identifying and managing the causes and consequences of sleep loss and fatigue is a critical health and safety consideration.

Sleep and fatigue in tourism employees.

Work hours and job requirements in the tourism industry are likely to result in elevated levels of fatigue, particularly as a consequence of inadequate sleep. Inadequate sleep contributes to fatigue, and is specifically associated with impaired cognitive performance, including lapses in attention and errors (Dorrian et al., 2006; Dorrian et al., 2008; Dorrian, Baulk, & Dawson, 2011; Ferguson, Paech, Dorrian, Roach, & Jay, 2011), as well as poorer mood (Paterson et al., 2011), and sickness-related absenteeism (Reynolds et al., 2017; Reynolds, Broussard, Paterson, Wright Jr., & Ferguson, 2017).

In the service industries, the negative outcomes associated with inadequate sleep and fatigue have repercussions for the provision of service, and for health comprising physical, mental and social wellbeing (henceforth ‘wellbeing’) (World Health Organisation, 2020) in employees. In the tourism worker context, fatigue has been linked with the ability to perform emotional labour (Lee, Moon, Lee, & Kim, 2014). Further, long work hours and insufficient breaks are linked with reduced motivation and poorer customer service in the hospitality sector (Poulston, 2009), and more broadly, with increased turnover (Martin, Sinclair, Lelchook, Wittmer, & Charles, 2012). This could in part be due to poorer sleep and mental health in workers engaged in longer work hours, as previously shown in young hospitality and tourism employees (Brand, Hermann, Muheim, Beck, & Holsboer-Trachsler, 2008). These negative outcomes can affect customer experience through impacts on worker mood and motivation, quality of service and absenteeism. Thus, there are significant benefits for employers in considering the experience of sleep loss and fatigue in tourism employees.

Tourism context.

Marine protected areas with World Heritage status such as the Great Barrier Reef are an important drawcard for Australia as a tourism destination. From 2013 to 2019, there were approximately one million visits per annum to the Great Barrier Reef from Cairns (Great Barrier Reef Marine Park Authority, 2020). The 2016/17 coral bleaching events received global media coverage and conveyed a negative image based on coral damage and decline which led to a reduction in visitor numbers (Prideaux, Pabel, Thompson, & Cassidy, 2018). In 2017, 69% of tourists were found to be either “very” or “extremely” motivated to visit the Great Barrier Reef before it was gone, due to a phenomenon called “last chance tourism” (Piggott-McKellar & McNamara, 2017). A further coral bleaching event in 2020 was severe and more widespread (ARC Centre of Excellence for Coral Reef Studies, 2020) and thus visitor numbers may increase further in the future.

The approximately 2.4 million visits made to the Great Barrier Reef Marine Park via commercial tourism vessels annually (Great Barrier Reef Marine Park Authority, 2020) contribute AUD\$6.4 billion in value-added activity and create over 64,000 direct

and indirect jobs (Deloitte Access Economics, 2017). It is clear that the sector generates high revenue and is a crucial component of the tourism industry in Australia. The impacts of sleep and fatigue on tourism employees are therefore critically important for the Australian reef tourism industry in a number of contexts.

Research aim and objectives

To ensure a sustainable and healthy reef tourism workforce, there is a need to better understand the experience of sleep loss and fatigue for reef tourism workers. Our aim was to determine the causes and consequences of sleep loss and fatigue specific to reef tourism workers. Within this overarching research aim, the key objectives of this study in current reef tourism employees were to:

- (1) identify specific causes of sleep loss and fatigue,
- (2) explore the consequences workers perceive as a result of poor sleep and fatigue, and
- (3) provide a qualitative evidence base for employers in this industry to better inform potential intervention avenues to improve sleep and fatigue management.

Methods

Theoretical framework

This analysis adopts Baum et al.'s (2016) taxonomy of workforce research in tourism and hospitality (see Table 1 for a summary) to provide insight into the causes and consequences of fatigue in the reef tourism industry. Baum et al.'s taxonomy (herein referred to as "the taxonomy") recognizes that certain factors can and do impact the workforce characteristics and practices across stratified levels. These comprise the "micro" (individual worker characteristics), "meso" (organizational and group level practices), and "macro" (global, economic, and legislative) levels. The taxonomy also highlights that research should consider a more holistic approach to knowledge development on tourism workforce issues. This is important when considering the overlap between "micro-meso" level factors in the unique context of tourism where customer–employee–organizational interactions are critical for business outcomes (Baum et al., 2016). Identification of factors related to fatigue and fatigue risk management, and their corresponding 'location' within the taxonomy is an important tool for mapping areas requiring closer attention.

Use of the taxonomy is ideal as little is currently known about the causes of sleep loss and fatigue in this worker population (and indeed, more broadly in the tourism workforce). While we can infer from existing literature in other sectors that sleep loss and fatigue are likely an issue in this workforce due to work hours and job requirements, there are no data to inform interventions which may improve wellbeing in reef tourism workers. As seen in Table 1, the taxonomy can allow for mapping of specific causes of sleep loss and fatigue at each level. Through this lens, we are able to identify causes across different dimensions. These include: (1) causes attributed to the behaviour of individual workers; (2) causes that arise from the interplay of employee, tourist and employer, where organizational systems or human resources factors influence sleep loss and fatigue; and (3) causes that originate as a consequence of higher level supply and demand issues.

Applying the taxonomy will inform subsequent participatory design approaches for reducing sleep loss and fatigue in this worker population. Application of the taxonomy of workforce research in this study reflects the first stage of a participatory design process, which recognizes that employees play a crucial role as contributors to change (Vink, Imada, & Zink, 2008), and in identifying where intervention may be most efficacious.

Study design

Data were collected using a semi-structured focus group methodology, combined with the Scenario Invention Task Technique (SITT). The SITT is a creative and generative way of understanding how people engage with challenging aspects of work and requires participants to simulate their work and how they perform tasks by creating insightful scenarios (Naweed, 2015). The SITT has been successfully applied in the context of safety-critical work in aviation (Naweed & Kingshott, 2019), and in rail (Naweed, 2013) where this technique has also been used to identify causes and consequences of fatigue (Filtness & Naweed, 2017). The transferability and credibility of this approach as it relates to qualitative reef tourism studies has already been explored in detail (Pabel & Naweed, 2019).

Participants

Eight focus groups were conducted by one interviewer with 42 employees (20 female, 22 male). All participants were currently working in the reef tourism industry in Far North Queensland, Australia. Employees were from a diverse range of businesses, and engaged in various roles including reservation staff ($n = 5$), cruise attendants ($n = 3$), boat skippers ($n = 5$), scuba diving instructors ($n = 22$), operations managers ($n = 4$), a purser ($n = 1$), and food and beverage attendants on vessels ($n = 2$). Of the staff who were on-board employees (working on boats on the Great Barrier Reef), a mix of day tours (sleep at home) and liveaboard (requiring overnight sleep on board with customers) employees participated. Country of origin varied, with 52% ($n = 22$) identifying as Australian.

Table 1

Summary of key examples from the taxonomy of workforce research specific to the tourism industry (Adapted from T. Baum et al., 2016).

Taxonomic level	Key examples from taxonomy of workforce research
Micro (<i>individual tourism worker characteristics and motivations for employment</i>)	Worker behaviour Characteristics of individual workers Worker attitudes Micro-enterprises and family run businesses
Micro-Meso (<i>customer-employee-organization interface</i>)	The work environment Customer/tourist perceptions of treatment of workers Characteristics of the job Customer-employee interactions HR management
Meso (<i>e.g. organizational systems, management structures/approaches, and human resource management factors</i>)	HR systems HR practices Organizational performance Group-level outcomes Labour mobility Labour supply and demand Legislation and regulation Global trends and developments
Macro (<i>e.g. supply and demand for tourism services, local / national / transnational influences</i>)	Economic cycles Transnational agencies Comparative studies Education and training Government policies

Procedure

Following a study briefing and receipt of informed consent, focus groups were structured to prompt participants' views on a variety of topics. Table 2 outlines the structure followed during the sessions including example questions. General questions about sleep, fatigue management strategies, and experiences of emotional labour were incorporated, and the overall content was attributed to different levels of the taxonomy. The SITT was initiated halfway into each session. Participants were asked to invent an everyday negative customer-service scenario for an employee working in the reef tourism industry. In some cases, multiple scenarios were generated by a single individual. Participants then explained their scenario to the group, with attention to specific points or factors of interest (i.e. weather conditions, customer and crew characteristics). Crucially, participants were then asked to consider and describe how they perceived their scenario could change if they were fatigued.

Table 2

Overview of the focus groups with examples of content, taxonomic attribution (micro, meso, and macro characteristics), and example questions.

Class of question	Example content	A priori taxonomic attribution ^a	Example question
Ice breaker	General experience and perspectives	<ul style="list-style-type: none"> • Characteristics of the worker • Worker behaviour 	In one word, describe your relationship with sleep. Do you think you get good quality sleep?
Prospective causation	Fatigue, role of sleep	<ul style="list-style-type: none"> • Worker behaviour • Worker attitudes • Customer-employee interactions • Characteristics of the job • Group-level outcomes 	Do you think how much you sleep affects your work? How?
Scenario simulation	Typical workplace challenge, and in the context of fatigue	<ul style="list-style-type: none"> • Worker behaviour • Worker attitudes • Customer-employee interactions • Characteristics of the job • Group-level outcomes • Legislation and regulation 	Invent an everyday challenging scenario that may result in a negative customer service situation. What if you were fatigued? Consider the same scenario, but this time from this perspective (i.e. feeling fatigued)

^a Content attributed to different levels of the taxonomy of workforce research in tourism employees (Baum et al., 2016).

Data analysis

Focus groups were recorded, transcribed verbatim, and de-identified to ensure confidentiality for participants and their employers. Overall, data from 57 scenarios were analyzed with NVivo (version 11, QSR). Analysis involved identifying and inductively coding any emergent categories within an overall deductive thematic structure of causes and consequences using a structured Grounded Theory approach (Glaser & Strauss, 1967). To ensure the transferability of the qualitative data, extensive use of quotes from the invented scenarios and illustrative examples were made in reporting results (De Crop, 2004).

Key themes were then linked with the taxonomy to guide a clear understanding of where causes of sleep loss and fatigue originate for workers. This was facilitated by connecting transcribed worker dialogue (including commentary around selected quotations) with taxonomic features. Factors could be perceived to be relevant at multiple levels, or related to an interaction of taxonomic levels (for example the micro-meso overlap).

Findings

Each of the eight focus groups covered topics of sleep and fatigue. A narrative overview of the findings within the overarching themes of causes and consequences associated with sleep loss and fatigue is provided. Illustrative participant responses are given where appropriate and relevant to contextualize the selection of sub-themes.

Causes of sleep loss and fatigue in reef tourism workers

A catalogue of 27 causes of sleep loss and fatigue were identified. The mapping of causes against taxonomic levels is shown in Table 3. Factors contributing to sleep loss and fatigue were diverse, and spanned multiple taxonomic levels. The causes are discussed below under two sub-themes; (1) the sleep environment, and (2) the work environment and responsibilities.

The sleep environment

Workers identified several environmental contributors to sleep loss. These included disruption from other members of the household, as well as other environmental noises (e.g. neighbours, dogs barking). Workers also identified symptoms associated with difficulty initiating and/or maintaining sleep, including waking and having trouble getting back to sleep, or having trouble falling asleep due to worry about work or getting sufficient sleep.

The impact of work on an individual's ability to fit in social and domestic responsibilities was associated with insufficient sleep (*"[you] try and fit in the social part of your life and then the house and everything else that you have got going on"*). For others, the absence of a routine or discipline with bedtime behaviours was identified as a factor contributing to sleep loss. (*"I think my lack of sleep is just due to my lack of discipline"*). Workers also acknowledged the impact of social media and technology more broadly on their sleep. This was particularly apparent for international employees remaining connected with family and friends overseas. (*"... part of it is also social media contact. I keep my phone on loud at all times in case I get calls and texts at weird hours which is a pain in the butt"*).

The work environment and responsibilities

A large proportion of identified causes of sleep loss and fatigue related to the work environment and responsibilities. A number of strategies for managing fatigue were also identified as causes of sleep loss and fatigue, including caffeine consumption (*"...coffee keeps me awake. I hate myself for having coffee late at night"*). Exposure to heat and sun were perceived to increase the experience of fatigue and feelings of sleepiness. Further, adverse weather conditions, managing unwell customers during rough seas, and riskier conditions at sea requiring higher vigilance were perceived to increase fatigue (*"[it is] the sea conditions because I know we're going to have a pretty ordinary day when half the boat is spewing and they go 'is it always like this?'"*).

Standby conditions (i.e. waiting for a call in to work) were associated with poorer sleep, irrespective of whether workers were actually called for work the next day or not. One participant reflected:

If you're on standby, you can't sleep in and then miss the phone call...[y]ou can't get too relaxed being on standby, but it is a bit rubbish because you're up ... 05 h30 in the morning ready to go to work at 06 h30 and then all of a sudden, I don't have to go to work, but you're up so you got rubbish sleep again".

The need for standby working arrangements was seemingly accepted as an inherent characteristic of the job. However, conditions for standby, and for rosters more broadly, varied considerably between workers. Dissatisfaction with unpaid standby conditions was expressed by some participants. Comparisons were drawn to other industries where standby is financially compensated. Others expressed feeling obligated to go into work on their days off, even when not on standby, if they received a call. There was an overlap between worker attitudes towards their colleagues and work environment, and the pressure to work when rostered off.

Table 3

Causes of sleep loss and fatigue in reef tourism workers, and the corresponding level from the taxonomy. Tick marks reflect a cause identified by workers, and establish where the causes fall at taxonomic levels.

Taxonomic level	Micro		Micro-Meso				Meso				Macro											
	Worker behaviour	Characteristics of individual workers	Worker attitudes	Customer-employee interactions	The work environment	Characteristics of the job	Customer/tourist perceptions of treatment of workers	Micro-enterprises and family-run small businesses	Organizational performance	HR management	HR practices	HR systems	Group-level outcomes	Labour mobility	Labour supply & demand	Legislation & regulation	Transnational agencies	Comparative studies	Global trends & developments	Education & training	Government policies	Economic cycles
Sleep environment																						
Partner, children or pets disrupt sleep opportunities		✓																				
Nocturnal noise leads to waking (home environment)		✓																				
Difficulty getting back to sleep once awake		✓			✓																	
Difficulty falling asleep due to work related stress/worry/rumination		✓			✓	✓																
Trouble with sleep onset		✓	✓																			
Nocturia		✓																				
Alarm anxiety	✓	✓			✓	✓																
Worrying specifically about getting sufficient sleep	✓	✓			✓	✓																
	Worker behaviour	Characteristics of individual workers	Worker attitudes	Customer-employee interactions	The work environment	Characteristics of the job	Customer/tourist perceptions of treatment of workers	Micro-enterprises and family-run small businesses	Organizational performance	HR management	HR practices	HR systems	Group-level outcomes	Labour mobility	Labour supply & demand	Legislation & regulation	Transnational agencies	Comparative studies	Global trends & developments	Education & training	Government policies	Economic cycles
Pressure (and desire) to fit in social and domestic responsibilities around work	✓	✓	✓																			
Lack of discipline and routine before bed	✓	✓	✓																			
Social media and technology	✓	✓	✓																			
Work environment and responsibilities																						
Caffeine consumption	✓	✓																				
Heat and sun					✓	✓																
Adverse weather conditions					✓	✓																
Standby conditions					✓	✓		✓														
Customer to crew ratio and overbookings									✓	✓	✓	✓	✓	✓	✓						✓	
Customer contact (night and day)				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							
Limited, insufficient, or disturbed sleep opportunities during liveaboard shifts				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							
Rapid turnarounds (late night to early starts), especially on liveaboards				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							
	Worker behaviour	Characteristics of individual workers	Worker attitudes	Customer-employee interactions	The work environment	Characteristics of the job	Customer/tourist perceptions of treatment of workers	Micro-enterprises and family-run small businesses	Organizational performance	HR management	HR practices	HR systems	Group-level outcomes	Labour mobility	Labour supply & demand	Legislation & regulation	Transnational agencies	Comparative studies	Global trends & developments	Education & training	Government policies	Economic cycles
Work responsibilities 24/7				✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓							
No rest breaks provided or allowed for during work hours				✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓						
Working beyond contracted hours				✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓						
Insecure or uncertain work hours				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓
Woken specifically for work when sleeping at home				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						
Working with volunteer staff				✓				✓		✓	✓	✓	✓	✓	✓	✓						
Crew inexperience (particularly supporting junior/novice staff members)									✓	✓	✓	✓	✓	✓	✓					✓		
Variability in demand for reef boat services							✓			✓	✓	✓	✓	✓	✓							

A number of occupational contributors to poor sleep and fatigue were reported that are unique to the reef tourism industry. Long and often undocumented work hours were reported (*“the reality is a lot of these guys will crank out 12-14 hour days and there will be no written record whatsoever”*). Many indicated that they were required to sleep onboard during overnight trips. Workers linked these circumstances to shorter sleep opportunities and regular disturbance, largely as a consequence of job requirements and sleep environment. Particularly challenging is that tourists and workers spend 24/7 together in a confined environment (*“[t]he work hours are all over the place if you’re on liveboards and you get four hours’ sleep a night”*). The need to work rapid turn-arounds and unplanned work hours, and the perceived need to be available to work almost 24/7 both for boat operations and for customer service reasons further impacted fatigue (*“working in liveboards...[o]ften, you’d be getting to bed at 2230, 2300 at night, up early the next morning and then anything happens during the night. Rough nights, you don’t get sleep or engine noise, or a passenger has an issue”*).

The 24/7 nature of reef tourism work was not limited to liveboard experiences. Personnel at the management level discussed the pressures of constant job demands. This was expressed by one participant as: *“you are constantly working and you don’t ever stop”*. A number of participants also felt that the breaks they received were inadequate. In some instances, staff reported that they received no formal breaks and needed to eat whilst still interacting with customers. For workers who achieved breaks, it was felt that the priority was that they work around the operational needs of the boat rather than the needs of workers for food, toilet or rest. Further compounding demands were requirements to supervise new or volunteer staff when already fatigued. Some workers reported that their company engaged volunteers to support crew, but often this introduced additional complexity rather than alleviated job stress.

“We get volunteers...because I can’t do my job on my own and they don’t want to pay anyone else to do it, so I get volunteers. A new one every day or is it a week? Pretty much a new one every day. Believe me it is...mentally exhausting”.

Consequences of sleep loss and fatigue in reef tourism workers

Worker wellbeing

Consequences of sleep loss and fatigue are summarized in Table 4. Reef tourism workers articulated the consequences of sleep loss and fatigue in terms of how it impacted them as individuals, their ability to perform their required duties effectively and safely, and the quality of their customer service. Conversations across all eight focus groups identified that mood was commonly impacted by sleep loss and fatigue. It was expressed as general grumpiness and irritability, short temperedness, and reduced tolerance when poor sleep or increased fatigue occurred. Many respondents suggested that these feelings were often transient: *“I have my days. Some days I can just function okay with not enough sleep. Some days, I can’t, but when I can’t, it’s pretty terrible”*.

Personal experiences of stress, levels of concentration and the ability to socialize outside work were all reported to be nega-

Table 4

Consequences of sleep loss and fatigue in reef tourism workers.

Area of impact	Consequence(s) of sleep loss and fatigue
Worker wellbeing	Poor mood (anger, grumpiness, irritation, anxiety, increased emotional responses overall, disinterest) Burnout Exhaustion and tension at home after work Pressure on personal relationships at home (friendships and intimate relationships) Poor mental and physical health overall ('sickness') Noticeable physical fatigue Reduced healing Significant weight loss Increased injury risk Reduced speed and efficiency at work (poor functioning) Trouble providing instructions to customers and staff Reduced concentration or focus ('vigilant attention') Altered decision-making Making errors (paperwork, missing customers at risk on lookout) Dozing/drifted on duty Microsleeps, especially during mundane or low effort tasks (watches, lookout) Reduced capacity to ensure a safe customer and employee environment
Ability to perform required duties	Needing to sleep on shift Grogginess/inertia 'Going into autopilot' Reduced patience with the crew Cutting corners Perceived burden to your teammates Reduced capacity to perform emotional labour Daydreaming and intrusive thoughts Reduced tolerance/patience with customers Bad customer reviews

tively impacted by sleep loss and fatigue. While most experiences were expressed in terms of negative consequences associated with sleep loss, some respondents identified the benefits of achieving sufficient sleep. Indeed, participants highlighted that sleep was understood to be an essential component of wellbeing. Participant examples included "...seven or eight hours [of sleep and] I'm the happiest person on the boat", and "sleep is kind of the fuel that you put through your body. It's like food. It's like exercise. It's just part of the ingredients that you need."

While many participants shared acute (short-term) experiences of negative mood related to a previous night of poor sleep, some described more chronic (long-term) impacts on their wellbeing. Burnout was mentioned as a consequence of fatigue in the worker population, and there was recognition of the impact of fatigue on mental wellbeing: "[i]t affects your mental state. It affects your personality". Negative impacts of fatigue on interpersonal relationships at work, at home, and in social environments, were also conveyed.

The highly physical nature of many reef tourism jobs was recognized as a contributor to fatigue. Comparisons with other physical activities were used to illustrate the extent of the physical health demands of the job, for example: "[i]t's like running a marathon every single day". Participants reported headaches, and in some instances, changes in gastrointestinal function related to work demands: "...your bowel habits change because you haven't got time to go...I know that's really – but let's be really honest. It does". Impacts of poor sleep and fatigue were noted on existing injuries, including flares of pain and longer healing time, as well as higher prevalence of new injuries. One participant reported observing unintended weight loss in colleagues.

Ability to perform required duties

Consequences of sleep loss and fatigue were most commonly expressed in terms of capacity to perform duties required for work (see Table 4). This was anticipated given the context of the negative customer service scenarios generated in the study. These discussions yielded rich insight into the specific duties which workers felt were impacted by sleep loss and fatigue. Participant responses suggested they understood the impact of both insufficient sleep and fatigue on their capacity to perform work efficiently and effectively. Productivity losses were commonly mentioned: "...if you don't sleep your...productivity will drop, especially in the tourism industry because it's everything about smiles and hospitality and customer service". This included less inclination to 'go the extra mile': "I am just not willing to do any more than what I have to do...I just do the bare minimum".

The safety of crew and customers was a concern, ranging from errors and mistakes through to conversations about risk and safety on the water. Recognition of errors and mistakes occurred in a range of roles and responsibilities, varying from reports of mistakes (e.g. errors in paperwork) to reflection on potential adverse safety outcomes such as how easy it is to miss indicators of health conditions on forms when tired. Safety was also raised as a concern on the water when fatigue levels were high, with one participant stating: "[you may] not pay attention to one person in your group [who may need help] because you are looking at someone else in your group when you are tired and it's all day every day".

Participants recognized that experience and task repetition may be protective when fatigued, and expressed concern about the relative inexperience of new crew members when fatigued. For example, one participant conveyed the impact of this on reduced levels of situation awareness:

"Another one I used to see a lot of was with new crew not being used to an operation that keeps going in their sleep. By the end of the trip, they don't know what is going on, they can't see what is in front of them. It gets to the point where the more senior crew are: 'All right, now pick up the brooms, sweep the floor.' The ability to recognize what is going to happen next and anticipate what needs to be done just evaporates after a few days and then of course, if they need prompts to do their normal tasks, what happens when something unexpected comes..."

Experience in the job was perceived positively in this workforce. However, others recognized that certain tasks (e.g. maintaining supervision of snorkellers and acting immediately in the event of an emergency) were more challenging when sleepy or fatigued, even for those with experience. Micro sleeps and distractibility during activities requiring vigilance were discussed by a number of workers, for example: "That's where the microsleeps happen because you're standing there and you can't talk to anyone, you can't listen to music, you just have to watch snorkellers snorkelling and count them to make sure none of them have drifted away. That's like counting sheep".

Sleep loss and fatigue were recognized as dangerous for both workers and for the customers placed in their care. Participants recognized the responsibility associated with having inexperienced swimmers and divers on board, and the added risk (beyond impacts on customer service) associated with conducting these jobs when fatigued: "[i]t is not just about putting a smile on your face, it's about keeping people safe". Some of these risks were specific to roles, particularly for those required to supervise inexperienced patrons on the boats: "if you are a diving instructor, you're taking new divers like intro divers and you screw up, people can die. People die while diving, you're not just talking about making sure someone has a good day at the park. You do have lives in your hands". Finally, there was discussion about passenger-crew ratios, and the impact of current requirements on the ability to operate safely within a business model that values cost-effectiveness. During discussions about work roles, fatigue and expectations, some workers felt that current passenger-crew ratios were not always safe for operations, especially in association with overbookings: "[y]ou can legally run the boat, you can't safely run the boat".

The impact on interactions with customers was discussed in all focus groups. Increased irritability, reduced tolerance, and increased pressure to control responses to negative or frustrating customer interactions were common. There was also a reduced capacity to accommodate what was referred to as a "care factor" about what customers were doing on board as long as it was not something they viewed as life threatening or "stupid". In the same vein, workers felt unwilling to "do that extra bit" when

fatigued. Emotional labour was perceived as more challenging when fatigued: “*the more tired you are, the harder it is to face someone to give them customer service*”. Workers also felt that a potential consequence of sleep loss and fatigue was negative customer reviews (actual, or perceived risk thereof).

Discussion

The current study is the first to investigate, identify and explicitly report prevalent sleep loss and fatigue in reef tourism workers. Perceived causes were multifactorial, ranging from characteristics and attitudes of individual workers (micro level), through to the nature of tourism work (meso level) and society more broadly (macro level). Our intent was to characterize the causes of sleep loss and fatigue and identify where they originate in the tourism workforce taxonomy (Baum et al., 2016). This highlighted both the diversity, and in many instances, complexity, of the causes of sleep loss and fatigue in this sample of reef tourism workers. Perceived consequences of sleep loss and fatigue in reef tourism workers were also identified, providing a foundation for future interventions for health, safety and wellbeing.

There is a complex interplay between micro, meso and macro level factors which are perceived to influence sleep loss and fatigue in reef tourism workers. Our study highlights the limitations of focusing simply on worker attitudes and behaviours, which has been the dominant paradigm in the small body of tourism workforce research to date (Baum et al., 2016). While some causes of sleep loss and fatigue were indeed attributed to the micro-level (and to worker attitudes and behaviours), this was limited primarily to the workers' sleep environments. We found work factors which were perceived to impact directly on the habitual sleep/wake behaviour of employees (Broussard et al., 2017), which can in turn impact health and wellbeing. The unique insights gained from the SITT approach provide the groundwork for future development of interventions informed by participatory design processes that target root causes of sleep loss and fatigue *beyond* individual worker sleep environments.

Participants were aware of the consequences of sleep loss and fatigue. This was coupled with an awareness of the high-level responsibilities that rest with crew and employees, particularly when out on the open water. While some workers had adjusted their lifestyles to suit their employment, many expressed frustration and dissatisfaction with work conditions. Some participants felt that employer-led rostering was suitable for managing fatigue, while others identified work conditions suggestive of a need to improve rostering and management of staff work hours. The discussions within focus groups illustrated that some employers are already providing work environments which are conducive to managing sleep and fatigue (particularly in relation to scheduling). This is promising, and suggests that there are exemplars within the industry which could be used to further the discussion around healthy scheduling arrangements.

Workers are quite aware of the consequences of sleep loss and fatigue for their wellbeing. Physical wellbeing was reported in terms of increased work-related injuries, consistent with a recent meta-analysis which showed that workers from diverse industries with sleep problems were at 1.62 times the risk for workplace injuries (Uehli et al., 2014). Further, gastrointestinal complaints are commonly reported by shift workers, and are a likely consequence of disturbed timing of sleeping and eating behaviours associated with non-standard working hours (Reynolds, Broussard, et al., 2017).

Findings of negative mental wellbeing reported by reef tourism workers were in line with existing findings on the relationship between short sleep and negative mood in different worker cohorts (Kalmbach, Arnedt, Song, Guille, & Sen, 2017; Sakamoto et al., 2013). Poor sleep has also previously been linked with burnout in other worker cohorts (Metlaine et al., 2018), including firefighters (Wolkow et al., 2019) and medical students (Wolf & Rosenstock, 2017). Similarly, negative impacts on social wellbeing were supported by literature which suggests that social functioning is affected by disturbed sleep (Dorrian, Centofanti, Smith, & McDermott, 2019). Taken together, reef tourism workers perceive their wellbeing is adversely affected, and findings suggest intervention and support are needed to improve outcomes.

Connection to the taxonomy and implications for future research

To the best of our knowledge, this is the first study to consider and explicitly link sleep loss and fatigue in this workforce. Thus, at present, designing evidence-based interventions and recommendations to improve health and wellbeing is problematic. Our qualitative synthesis illustrated that *causes* of sleep loss and fatigue span the taxonomy from micro (individual worker factors) to macro (the nature of tourism work, and the interplay with society) levels, and suggest that to understand sleep loss and fatigue in reef tourism workers, we must consider the interdependencies across the framework. It is also clear that interventions to improve healthy and sustainable sleep environments at the individual worker level may be beneficial. We suggest opportunities for change which are shared by the worker, the workplace, and, the tourism industry more generally. An encouraging perspective is that the diversity in contributing factors affords multiple pathways for intervention to improve sleep and fatigue in this workforce.

While workers reported some knowledge about the benefits of sleep (and consequences of poor sleep and fatigue), worker behaviours and attitudes are also potential causes of sleep loss and fatigue in this workforce. Some participants identified that they do not do enough, or could do more, to improve their sleep, which is consistent with previous reports in young Australian workers (Paterson, Reynolds, Duncan, Vandelanotte, & Ferguson, 2017). Young Australian workers are also more likely to report making errors at work when they have had poor sleep (Ferguson et al., 2019) suggesting an awareness of impacts on performance, and by extension, opportunity for intervention. Some participants reported difficulties initiating and maintaining sleep. Thus, identifying any clinical sleep disorders in the first instance will be important for ensuring appropriate interventions are subsequently trialed. This would be an achievable first step in intervention research for sleep and fatigue in this workforce.

It should be noted that this will need to include the unique perspective of dual sleep environments for many workers, meaning both at home, and in sleeping quarters during liveaboard trips.

Workplace interventions could include sleep education programs, fatigue risk management strategies, napping policies, and modifying the work environment (Redeker et al., 2019). Interventions focused on individual worker behaviour should not, however, be undertaken in isolation or viewed as the sole approach to improving sleep loss and fatigue in this workforce. Fig. 1 highlights that the majority of causes identified by participants fell within the domain of work environment and responsibilities, with many interdependencies between macro, meso and micro-meso levels. Participants highlighted a diverse range of macro-level factors which will require input from employers, the tourism industry more broadly, transnational agencies and academics in order to facilitate meaningful discussion about interventions to improve wellbeing of the reef tourism workforce (Vink et al., 2008).

When compared with evidence-based strategies for workplace intervention, different intervention strategies will be needed to address different causes of sleep loss and fatigue in this worker cohort, as demonstrated by Fig. 1. Given that workers identified limited and disturbed sleep opportunities as causes of sleep loss and fatigue when at sea, modifying the work environment to improve sleep is a key area for consideration. This will also require further research as intervention studies with workplace modifications in this context are uncommon (Redeker et al., 2019). It is important to note however, that while this recent review of workplace interventions for sleep provides some potential strategies to improve sleep health in employees, none of the workplace studies were conducted in tourism employees and may not be as applicable as other workplace contexts.

It will be crucial to draw on the findings of our study when working with tourism employers to develop strategies to mitigate risks associated with fatigue. There is an opportunity to develop meaningful workplace-oriented interventions for this industry to improve sleep health. Developing relevant interventions should involve a participatory approach, such as the person-based approach (PBA) which has demonstrated efficacy in workplace interventions for wellbeing (Howarth, Quesada, Donnelly, & Mills, 2019). Our current work provides the first important step in this process by identifying perceived causes of sleep and fatigue directly from the workforce. The next stage in this process should be co-design and development of relevant interventions for this workforce.

It is important to recognize that complexity and interdependency do not have to be synonymous with difficulty in terms of managing sleep loss and fatigue more effectively in this workforce. A practical perspective is the view that opportunities for sup-

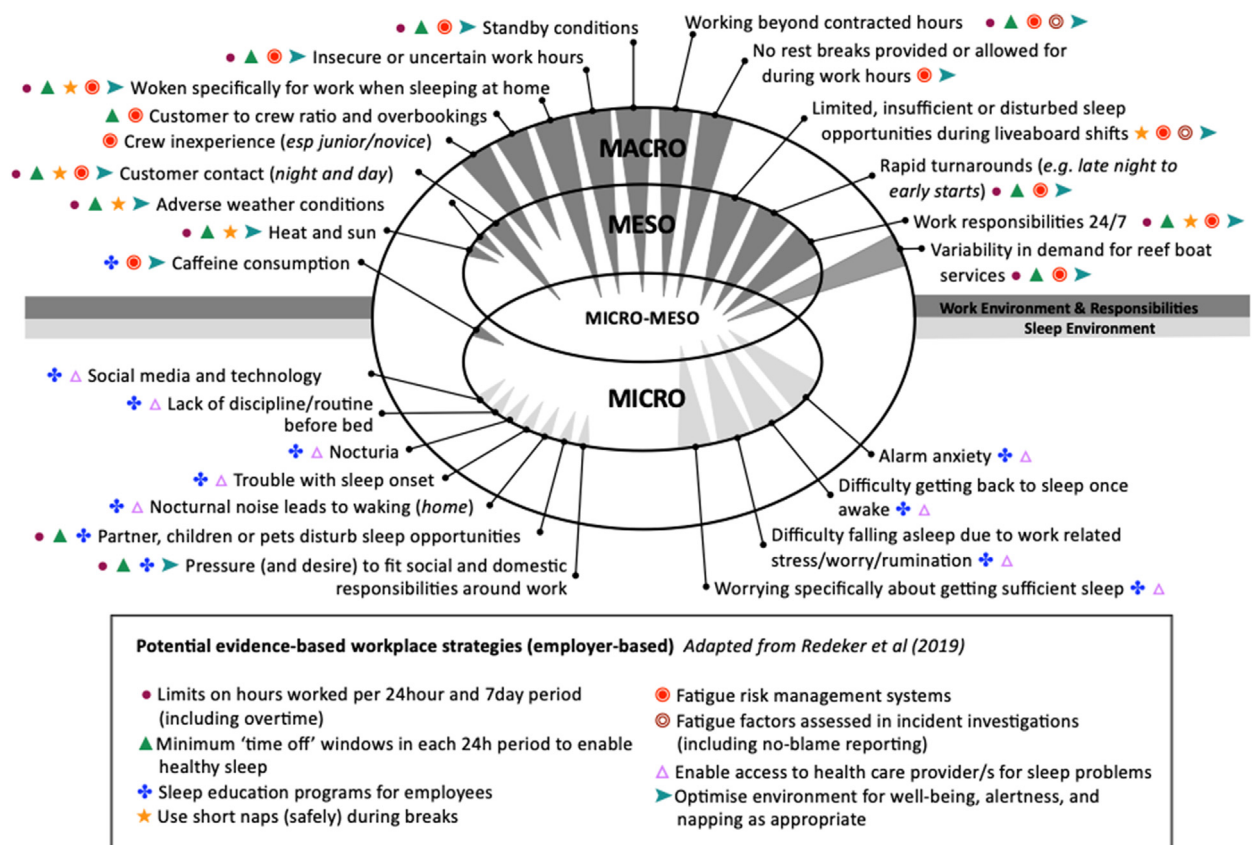


Fig. 1. Causes of sleep loss and fatigue in reef tourism workers. Relationship to the taxonomy is reflected by shading; where multiple taxonomic levels were reflected in worker comments, shading extends across boundaries. Causes related to the work environment and responsibilities are shaded dark grey, while causes related to the sleep environment are shaded in light grey. Potential evidence-based strategies for employer consideration are provided for consideration for each cause identified by reef tourism workers. Workplace strategies sourced and adapted from Redeker et al. (2019).

port and intervention with workers, their workplace, and the broader industry have the potential to address multiple causes. They also have the potential to offer options or strategies for improvement when adapting work arrangements is challenging, particularly at the macro level.

Managing the risks associated with fatigue

The intent of this study was to identify the perceived causes and consequences of sleep and fatigue in workers employed in the reef tourism industry. Regulatory requirements associated with formal fatigue risk management fell beyond the scope of discussions. However, participant perspectives on sleep and fatigue highlight the value for future work, particularly given the safety-critical nature of working at sea with customers. This is particularly relevant given examples of challenges to vigilant attention when workers report fatigue (such as when observing or 'looking out' for snorkelers in the water). This is not dissimilar to the rail industry, where track workers rely on lookouts to advise of oncoming trains while active work is undertaken (Naweed, Young, & Aitken, 2019). In both contexts, the safety of others depends on accurate monitoring of the situation. This is a relative weakness in the system for managing customer safety on the reef – and was well illustrated by one participant as 'counting sheep'. The monotonous and repetitive nature of this task may exacerbate the risk of fatigue and the complexity of this role should not be underestimated.

Some participants made specific reference to the work hours log and the requirement to produce certificates if inspected, but felt that the reliability and validity of these records would be most accurate if workers were completing these honestly themselves. Another consideration is that many employees in the reef tourism industry are transient, and maintaining knowledge and understanding of formal strategies to manage risk with fatigue in both small and large operations may be impacted by staff turnover. Managing the risks associated with fatigue involves a holistic approach to identification and management, and is a shared responsibility between employers and employees.

Beyond the key consideration of customer safety, it is also evident that managing sleep and fatigue in these workers has the potential to improve customer experience and related outcomes. In the context of reef tourism, fatigue-related impairments are perceived to interact with the capacity to perform emotional labour, complete required core duties efficiently (in some cases, safely) and take care of the worker themselves. Examples were provided indicating that current operational practices and self-management strategies are not perceived by workers to be adequate for managing risk associated with fatigue, particularly in regard to work hours and rest breaks. Future research and policy work will need to take account of the likely challenges for successful fatigue risk management previously highlighted in other sectors (e.g. transport (Gander et al., 2011)) such as insecure employment opportunities, transient workforces, and limited availability of skilled labour which are also endemic in the reef tourism industry.

Implications of the study

While policies and systems to manage fatigue could be considered a workforce issue at the macro and meso levels, it is important to note that numerous micro level factors including worker characteristics, attitudes and behaviours are all perceived to influence the management of sleep and fatigue in this workforce. Drawing on this early knowledge will be helpful when considering workforce-specific risk management approaches for fatigue in the future. We have demonstrated numerous opportunities within, and between, taxonomic levels for future research and intervention. Further, Fig. 1 highlights that there are some achievable interventions which could improve the quality of worker sleep at home, and during liveaboard periods.

While this will be an important first step, study findings also reflect that worker-focused interventions should not be conducted in isolation. Many of the challenges for sleep loss and fatigue faced by this workforce are systemic and perpetuated by precarious employment. The findings illustrate the importance of employer and industry-level changes in order to improve sleep and fatigue management in reef tourism workers. How these interventions are designed and implemented will require further attention. While our sample comprised employees and a small number of self-employed workers, it is important to note that top and middle management personnel will need to be involved in designing interventions to improve sleep and fatigue at the organizational level (Vink et al., 2008).

Strengths, limitations and future research directions

A key strength of this study was the use of the SITT to facilitate a more diverse exploration of the causes of sleep loss and fatigue, and thus specific insight into more structural causes at the meso and macro level. Importantly, this study goes beyond existing tourism studies which tend to focus on individual aspects of the taxonomy, and applies a holistic approach to understanding factors influencing the tourism workforce. The qualitative nature of this study allowed for rich depth and insight into the under-investigated topic of sleep loss and fatigue in reef tourism workers. The study is also strengthened by the potential transferability of the findings to other tourism settings. Sleep loss and fatigue management approaches may be a modifiable and accessible focus area to improve both worker wellbeing, and customer experience. Future studies should consider the perspectives of regulators, business/vessel owners, and governance representatives to gain insight into the regulatory and managerial challenges with managing sleep and fatigue in this industry.

Finally, while this research was conducted before the 2020 Covid-19 pandemic and associated travel lockdowns, it would be remiss not to acknowledge the unprecedented challenges the pandemic has brought to the global tourism industry. Small, regional communities in Far North Queensland are reliant on tourists who buy and consume local goods and services (e.g.

accommodation, restaurants and trips to local attraction including national and marine parks). With most countries currently in lockdown to minimize the spread of Covid-19, there are limited domestic and international flights and thus reduced tourism-related income. This is leaving local communities and economies vulnerable. While it is acknowledged that Covid-19 has affected tourists visiting the Great Barrier Reef, our findings on the causes and consequences of sleep loss and fatigue in reef tourism workers should be considered as services in this region (and many others) resume. It is also plausible that the impacts of Covid-19 may stretch to changes in emotional labour in terms of increased safety/hygiene practices on vessels, as well as interpersonal dimensions of tourism workforce roles, which can in turn influence fatigue.

Conclusion

As noted by Baum et al. (2016), the tourism workforce has been largely overlooked in favour of a focus on themes such as technology and marketing in tourism research. However, our study has identified causes of sleep loss and fatigue in the reef tourism industry and highlights the importance of understanding the impact of individual, social and organizational factors on sleep loss and fatigue. This is key as this workforce has a direct impact on the safety, productivity and thus the sustainability, of tourism operations. In addition to the potential impacts of sleep loss and fatigue on customer service and experience, reef tourism employees report that current work arrangements appear to have negative physical, mental and social wellbeing implications. Together with the known risks of sleep loss and fatigue in safety-critical environments, interventions are needed in this industry.

Based on the consequences reported by workers, there are benefits to be gained for all stakeholders (workers, employers, and customers) by managing the causes of sleep loss and fatigue more effectively. While several job-related characteristics are unlikely to change (e.g. weather conditions, shift work, need for standby), working with employers who are currently managing effective rosters and standby conditions will be an important first step for understanding how these practices can be best implemented. Our findings provide the required qualitative evidence base to support the introduction of interventions tailored to the reef tourism workforce. Designing and developing these interventions in collaboration with employers and employees is an important next step. There is a clear need to ensure staff at all levels are well versed in the regulatory requirements for work hours and rest breaks in this industry, and for appropriate work and rest breaks to be applied consistently in the industry.

Statement of contribution

Contribution to knowledge, theory, policy or practice offered by the paper

Tourism operations require working conditions which leave workers vulnerable to sleep loss and fatigue. Sleep loss and fatigue have profound health and safety impacts. Further, in an industry reliant on customer experience and satisfaction, managing sleep loss and fatigue actually has potential to improve business outcomes. Despite this, sleep loss and fatigue in the tourism workforce remains poorly understood. For the first time, we provide a rich knowledge base related to the individual and occupational contributors to sleep loss and fatigue. Guided by Baum et al. (2016)'s taxonomy for tourism workforce, we highlight the industry, employer and individual factors which influence sleep loss and fatigue in this workforce.

How does the paper offer a social science perspective/approach

Crucial to our understanding of sleep loss and fatigue is recognition of the social relationships, and the role of both individual and occupational factors in the experience of sleep loss and fatigue. Our paper goes beyond a unidimensional exploration of the 'worker', and considers the holistic experience of sleep loss and fatigue in context of the broader landscape in which the tourism workforce operates.

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Declaration of competing interest

None.

References

- ARC Centre of Excellence for Coral Reef Studies. (2020). Climate change triggers Great Barrier Reef bleaching. <https://www.coralcoe.org.au/media-releases/climate-change-triggers-great-barrier-reef-bleaching>
- Baum, T. (2015). Human resources in tourism: Still waiting for change? A 2015 reprise. *Tourism Management*, 50, 204–212.
- Baum, T., Kralj, A., Robinson, R. N. S., & Solnet, D. J. (2016). Tourism workforce research: A review, taxonomy and agenda. *Annals of Tourism Research*, 60, 1–22. <https://doi.org/10.1016/j.annals.2016.04.003>.
- Black, R., & Weiler, B. (2005). Quality assurance and regulatory mechanisms in the tour guiding industry: A systematic review. *The Journal of Tourism Studies*, 16(1), 24–37.
- Brand, S., Hermann, B., Muheim, F., Beck, J., & Holsboer-Trachsler, E. (2008). Sleep patterns, work, and strain among young students in hospitality and tourism. *Industrial Health*, 46(3), 199–209. <https://doi.org/10.2486/indhealth.46.199>.

- Broussard, J. L., Reynolds, A. C., Depner, C. M., Ferguson, S. A., Dawson, D., & Wright, K. P. (2017). Circadian rhythms versus daily patterns in human physiology and behaviour. In V. Kumar (Ed.), *Biological timekeeping: Clocks, rhythms and behaviour* (pp. 279–295). New Delhi: Springer India.
- Brown, I. D. (1994). Driver Fatigue. *Human Factors*, 36(2), 298–314. <https://doi.org/10.1177/001872089403600210>.
- Chau, S. L., Dahling, J. J., Levy, P. E., & Diefendorff, J. M. (2009). A predictive study of emotional labour and turnover. *Journal of Organizational Behaviour*, 30(8), 1151–1163. <https://doi.org/10.1002/job.617>.
- Crawford, A., & Hubbard, S. S. (2018). The impact of work-related goals on hospitality industry variables. *Tourism and Hospitality Research*, 8, 116–124.
- Dawson, D., Reynolds, A. C., van Dongen, H. P. A., & Thomas, M. J. W. (2018). Determining the likelihood that fatigue was present in a road accident: A theoretical review and suggested accident taxonomy. *Sleep Medicine Reviews*, 42, 202–210.
- De Crop, A. (2004). Trustworthiness in qualitative tourism research. In J. Phillimore, & L. Goodson (Eds.), *Qualitative research in tourism*. London: Routledge.
- Deloitte Access Economics. (2017). At what price? The economic, social and icon value of the Great Barrier Reef. <https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-great-barrier-reef-230617.pdf>
- Dorrian, J., Baulk, S. D., & Dawson, D. (2011). Work hours, workload, sleep and fatigue in Australian rail industry employees. *Applied Ergonomics*, 42(2), 202–209. <https://doi.org/10.1016/j.apergo.2010.06.009>.
- Dorrian, J., Centofanti, S., Smith, A., & McDermott, K. D. (2019). Self-regulation and social behaviour during sleep deprivation. *Progress in Brain Research*, 246, 73–110. <https://doi.org/10.1016/bs.pbr.2019.03.010>.
- Dorrian, J., Lamond, N., van den Heuvel, C., Pincombe, J., Rogers, A. E., & Dawson, D. (2006). A pilot study of the safety implications of Australian nurses' sleep and work hours. *Chronobiology International*, 23(6), 1149–1163. <https://doi.org/10.1080/07420520601059615>.
- Dorrian, J., Tolley, C., Lamond, N., van den Heuvel, C., Pincombe, J., Rogers, A. E., & Drew, D. (2008). Sleep and errors in a group of Australian hospital nurses at work and during the commute. *Applied Ergonomics*, 39(5), 605–613. <https://doi.org/10.1016/j.apergo.2008.01.012>.
- Drury, D. A., Ferguson, S. A., & Thomas, M. J. W. (2012). Restricted sleep and negative affective states in commercial pilots during short haul operations. *Accident Analysis & Prevention*, 45, 80–84.
- Ferguson, S. A., Appleton, S. L., Reynolds, A. C., Gill, T. K., Taylor, A. W., McEvoy, R. D., & Adams, R. J. (2019). Making errors at work due to sleepiness or sleep problems is not confined to non-standard work hours: Results of the 2016 sleep Health Foundation national survey. *Chronobiology International*, 36(6), 758–769. <https://doi.org/10.1080/07420528.2019.1578969>.
- Ferguson, S. A., Paech, G. M., Dorrian, J., Roach, G. D., & Jay, S. M. (2011). Performance on a simple response time task: Is sleep or work more important for miners? *Applied Ergonomics*, 42(2), 210–213. <https://doi.org/10.1016/j.apergo.2010.06.010>.
- Filtness, A. J., & Naweed, A. (2017). Causes, consequences and countermeasures to driver fatigue in the rail industry: The train driver perspective. *Applied Ergonomics*, 60, 12–21. <https://doi.org/10.1016/j.apergo.2016.10.009>.
- Gander, P., Hartley, L., Powell, D., Cabon, P., Hitchcock, E., Mills, A., & Popkin, S. (2011). Fatigue risk management: Organizational factors at the regulatory and industry/company level. *Accident Analysis & Prevention*, 43(2), 573–590. <https://doi.org/10.1016/j.aap.2009.11.007>.
- Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldine.
- Grandey, A. A., & Sayre, G. M. (2019). Emotional labour: Regulating emotions for a wage. *Current Directions in Psychological Science*, 28(2), 131–137. <https://doi.org/10.1177/0963721418812771>.
- Great Barrier Reef Marine Park Authority. (2020). Great Barrier Reef tourist numbers. <http://www.gbrmpa.gov.au/our-work/reef-strategies/visitor-contributions/numbers>
- Hartzler, B. M. (2014). Fatigue on the flight deck: The consequences of sleep loss and the benefits of napping. *Accident Analysis & Prevention*, 62, 309–318.
- Heung, V. (2008). Effects of tour leader's service quality on agency's reputation and customers' word-of-mouth. *Journal of Vacation Marketing*, 14(4), 305–315.
- Howarth, A., Quesada, J., Donnelly, T., & Mills, P. R. (2019). The development of 'make one small change': An e-health intervention for the workplace developed using the person-based approach. *Digital Health*, 5, 2055207619852856. <https://doi.org/10.1177/2055207619852856>.
- Hulsheger, U. R., & Schewe, A. F. (2011). On the costs and benefits of emotional labour: A meta-analysis of three decades of research. *Journal of Occupational Health Psychology*, 16(3), 361–389. <https://doi.org/10.1037/a0022876>.
- Janes, P., & Wisnom, M. (2011). Changes in tourism industry quality of work life practices. *Journal of Tourism Insights*, 1(1), 107–113.
- Johnson, K., Huang, T., & Doyle, A. (2019). Mapping talent development in tourism and hospitality: A literature review. *European Journal of Training and Development*, 13(9), 821–841.
- Kalmbach, D. A., Arnedt, J. T., Song, P. X., Guille, C., & Sen, S. (2017). Sleep disturbance and short sleep as risk factors for depression and perceived medical errors in first-year residents. *Sleep*, 40(3). <https://doi.org/10.1093/sleep/zsw073>.
- Kecklund, G., & Axelsson, J. (2016). Health consequences of shift work and insufficient sleep. *BMJ*, 355, i5210.
- Lee, J. J., Moon, H. J., Lee, K. -J., & Kim, J. J. (2014). Fatigue and related factors among hotel workers: The effects of emotional labour and non-standard working hours. *Annals of Occupational and Environmental Medicine*, 26(1), 51. <https://doi.org/10.1186/s40557-014-0051-y>.
- Martin, J. E., Sinclair, R. R., Lelchok, A. M., Wittmer, J. L. S., & Charles, K. E. (2012). Non-standard work schedules and retention in the entry-level hourly workforce. *Journal of Occupational and Organizational Psychology*, 85(1), 1–22. <https://doi.org/10.1348/096317910x526803>.
- Metlaïne, A., Sauvet, F., Gomez-Merino, D., Boucher, T., Elbaz, M., Delafosse, J. Y., ... Chennaoui, M. (2018). Sleep and biological parameters in professional burnout: A psychophysiological characterization. *PLoS One*, 13(1), Article e0190607. <https://doi.org/10.1371/journal.pone.0190607>.
- Naweed, A. (2013). Psychological factors for driver distraction and inattention in the Australian and New Zealand rail industry. *Accident Analysis & Prevention*, 60, 193–204. <https://doi.org/10.1016/j.aap.2013.08.022>.
- Naweed, A. (2015). The "scenario invention task" (SIT): An innovative method for harnessing natural human creativity. *Paper presented at the 19th triennial congress of the international ergonomics association*. Melbourne: Australia.
- Naweed, A., Chapman, J., Allan, M., & Trigg, J. (2017). It comes with the job: Work organizational, job design, and self-regulatory barriers to improving the health status of train drivers. *Journal of Occupational and Environmental Medicine*, 59(3), 264–273. <https://doi.org/10.1097/JOM.0000000000000942>.
- Naweed, A., & Kingshott, K. (2019). Flying off the handle: Affective influences on decision making and action tendencies in real-world aircraft maintenance engineering scenarios. *Journal of Cognitive Engineering and Decision making*, 13(2), 81–101. <https://doi.org/10.1177/1555343418821507>.
- Naweed, A., Young, M.S., & Aitken, J. (2019). Caught between a rail and a hard place: A two-country meta-analysis of factors that impact track worker safety in Lookout related rail incidents. *Theoretical Issues in Ergonomic Science*, 20(6), 731–762. <https://doi.org/10.1080/1463922X.2019.1605630>.
- O'Leary, S., & Deegan, J. (2005). Career progression of Irish tourism and hospitality management graduates. *International Journal of Contemporary Hospitality Management*, 17(5), 421–432.
- Pabel, A., & Naweed, A. (2019). Scenario Invention Task Technique (SITT): a practical innovation for qualitative research in a reef tourism study. *Paper presented at the Travel and Tourism Research Association (TTRA) conference: Advancing Tourism Research Globally*https://scholarworks.umass.edu/ttra/2019/research_papers/89.
- Pabel, A., Naweed, A., Ferguson, S. A., & Reynolds, A. (2019). Crack a smile: The causes and consequences of emotional labour dysregulation in Australian reef tourism. *Current Issues in Tourism*, 1–15. <https://doi.org/10.1080/13683500.2019.1629579>.
- Pabel, A., & Pearce, P. (2016). Tourists' responses to humour. *Annals of Tourism Research*, 57, 190–205. <https://doi.org/10.1016/j.annals.2015.12.018>.
- Paterson, J. L., Dorrian, J., Ferguson, S. A., Jay, S. M., Lamond, N., Murphy, P. J., ... Dawson, D. (2011). Changes in structural aspects of mood during 39–66 h of sleep loss using matched controls. *Applied Ergonomics*, 42(2), 196–201. <https://doi.org/10.1016/j.apergo.2010.06.014>.
- Paterson, J. L., Reynolds, A. C., Duncan, M., Vandelanotte, C., & Ferguson, S. A. (2017). Barriers and enablers to modifying sleep behaviour in adolescents and young adults: A qualitative investigation. *Behavioural Sleep Medicine*, 1–13. <https://doi.org/10.1080/15402002.2016.1266489>.
- Piggott-McKellar, A. E., & McNamara, K. E. (2017). Last chance tourism and the Great Barrier Reef. *Journal of Sustainable Tourism*, 25(3), 397–415.
- Poulston, J. M. (2009). Working conditions in hospitality: Employees' views of the dissatisfactory hygiene factors. *Journal of Quality Assurance in Hospitality & Tourism*, 10(1), 23–43. <https://doi.org/10.1080/15280080902716993>.
- Prideaux, B., Pabel, A., Thompson, M., & Cassidy, L. (2018). The potential for coral bleaching to affect long-term destination sustainability. In B. Prideaux, & A. Pabel (Eds.), *Coral reefs: Tourism, conservation and management* (pp. 75–92). Abingdon, UK: Routledge's Earthscan Oceans.

- Redeker, N. S., Caruso, C. C., Hashmi, S. D., Mullington, J. M., Grandner, M., & Morgenthaler, T. I. (2019). Workplace interventions to promote sleep health and an alert, healthy workforce. *Journal of Clinical Sleep Medicine*, 15(4), 649–657. <https://doi.org/10.5664/jcs.m.7734>.
- Reynolds, A. C., Appleton, S. L., Gill, T. K., Taylor, A. W., McEvoy, R. D., Ferguson, S. A., & Adams, R. J. (2017). Sick leave absenteeism is associated with sleep problems independent of sleep disorders: Results of the 2016 Sleep Health Foundation national survey. *Sleep Health*, 3(5), 357–361. <https://doi.org/10.1016/j.sleh.2017.06.003>.
- Reynolds, A. C., Broussard, J., Paterson, J. L., Wright, K. P., Jr., & Ferguson, S. A. (2017). Sleepy, circadian disrupted and sick: Could intestinal microbiota play an important role in shift worker health? *Molecular Metabolism*, 6(1), 12–13. <https://doi.org/10.1016/j.molmet.2016.11.004>.
- Reynolds, A. C., Bucks, R. S., Paterson, J. L., Ferguson, S. A., Mori, T. A., McArdle, N., Straker, L., Beilin, L. J., & Eastwood, P. R. (2018). Working (longer than) 9 to 5: Are there cardiometabolic health risks for young Australian workers who report longer than 38-h working weeks? *International Archives of Occupational and Environmental Health*, 91(4), 403–412.
- Safe Work Australia. (2020). Fatigue. <https://www.safeworkaustralia.gov.au/fatigue>
- Sakamoto, N., Nanri, A., Kochi, T., Tsuruoka, H., Pham, N. M., Kabe, I., ... Mizoue, T. (2013). Bedtime and sleep duration in relation to depressive symptoms among Japanese workers. *Journal of Occupational Health*, 55(6), 479–486. <https://doi.org/10.1539/joh.13-0074-oa>.
- Slatten, T., & Mehmetoglu, M. (2011). Antecedents and effects of engaged frontline employees: A study from the hospitality industry. *Managing Service Quality: An International Journal*, 21(1), 88–107.
- Thomas, M. J. W., Paterson, J. L., Jay, S. M., Matthews, R. W., & Ferguson, S. A. (2019). More than hours of work: Fatigue management during high-intensity maritime operations. *Chronobiology International*, 36(1), 143–149. <https://doi.org/10.1080/07420528.2018.1519571>.
- Uehli, K., Mehta, A. J., Miedinger, D., Hug, K., Schindler, C., Holsboer-Trachsler, E., Leuppi, J. D., & Kunzli, N. (2014). Sleep problems and work injuries: A systematic review and meta-analysis. *Sleep Medicine Reviews*, 18(1), 61–73.
- Vink, P., Imada, A. S., & Zink, K. J. (2008). Defining stakeholder involvement in participatory design processes. *Applied Ergonomics*, 39(4), 519–526. <https://doi.org/10.1016/j.apergo.2008.02.009>.
- Winchenbach, A., Hanna, P., & Miller, G. (2019). Rethinking decent work: The value of dignity in tourism employment. *Journal of Sustainable Tourism*, 27(7), 1026–1043. <https://doi.org/10.1080/09669582.2019.1566346>.
- Wolf, M. R., & Rosenstock, J. B. (2017). Inadequate sleep and exercise associated with burnout and depression among medical students. *Academic Psychiatry*, 41(2), 174–179. <https://doi.org/10.1007/s40596-016-0526-y>.
- Wolkow, A. P., Barger, L. K., O'Brien, C. S., Sullivan, J. P., Qadri, S., Lockley, S. W., ... Rajaratnam, S. M. W. (2019). Associations between sleep disturbances, mental health outcomes and burnout in firefighters, and the mediating role of sleep during overnight work: A cross-sectional study. *Journal of Sleep Research*, 28(6), Article e12869. <https://doi.org/10.1111/jsr.12869>.
- World Health Organisation (2020). Constitution. <https://www.who.int/about/who-we-are/constitution>

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